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ABSTRACT ONLY

LIKE A WRECKING BALL: UNDERSTANDING GIANT PLANETS AS THE KEY TO FINDING EARTHS

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Jupiter-like planets are the key to understanding Earth-like planets. Their presence can disrupt the orbits of inner habitable worlds, or deliver life-sustaining water. While the search for Earth-like planets orbiting nearby stars garners the most attention, it is critically important to understand the presence and properties of giant planets in those systems. In the next decade, three space missions will provide unprecedented new opportunities for understanding the nature of these Jupiter analogs: Gaia, the James Webb Space Telescope, and the Nancy Grace Roman Space Telescope. We aim to take advantage of the multi-messenger synergy of these observatories, in combination with Australia's unique Minerva-Australis telescope array, to obtain a complete picture of the nearest extrasolar planetary systems. Dozens of cold giant planets are known from radial-velocity planet searches. But their true masses remain unknown due to the limitations of the technique. In Data Releases 4 and 5 (2025/26) the Gaia space astrometry mission will deliver the critical measurements of 3-dimensional architecture for these planetary systems. Combined with the minimum masses obtained from radial velocities, we will obtain the true masses of those planets. Our Minerva-Australis observatory is fully dedicated to radial-velocity measurements; it is the only such facility in the Southern hemisphere. We will use these data to better characterise nearby Jupiter analogs for which true masses and orbital inclinations can be derived with forthcoming Gaia data. With detailed knowledge of the properties of those giant planets, we can model the extent to which those planets deliver water to inner Earth analogs via comet impacts. These Jupiter analogs will also be prime targets for direct imaging by JWST and Roman.

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